ACP AMERICAN COLLEGE OF PROSTHODONTISTS
Your smile. Our specialty.®

Predictors of Patient Satisfaction with Removable Denture Renewal: A Pilot Study

Stefanie Krausch-Hofmann, MSc,[1] Line Cuypers, MSc,[1] Anna Ivanova, MSc,[2] & Joke Duyck, DDS, PhD[1]

[1]Department of Oral Health Sciences, KU Leuven, Belgium
[2]Interuniversity Institute for Biostatistics and Statistical Bioinformatics (I-BioStat) KU Leuven and U Hasselt, Leuven, Belgium

Keywords
Conventional denture; denture replacement; patient satisfaction; prognostic indicators.

Correspondence
Professor Joke Duyck, DDS, PhD, Department of Oral Health Sciences, KU Leuven, Kapucijnenvoer 7/a, box 7001, 3000 Leuven, Belgium. E-mail: joke.duyck@kuleuven.be

The authors deny any conflicts of interest.

Accepted July 9, 2016

doi: 10.1111/jopr.12537

Abstract

Purpose: Conventional removable dentures still play an important role in the treatment of lost teeth. A thorough understanding of the parameters that influence patient satisfaction is useful for deciding whether denture replacement is meaningful. From a clinical perspective, factors that can be measured before starting treatment are relevant. This pilot study investigated whether patient satisfaction after denture renewal was affected by aspects related to the old prostheses, type of jaw, and patient motivation for denture renewal.

Materials and Methods: Fifty subjects (mean age 68.2 ± 8.4) were provided with 74 removable dentures (partial n = 20, complete n = 54). Satisfaction was assessed before treatment and 3 months after new prosthesis insertion. *Total satisfaction 3-month post-insertion* (*TSP3*) merged 6 individual satisfaction items measured after treatment. *Change of total satisfaction 3-month post-insertion* (*CTS3*) represented the difference of total satisfaction when old and new prostheses were compared. The effect of the following independent variables was investigated: reason patients requested new dentures (fit, esthetics, broken denture, wear, advice of dentist, extractions), satisfaction with the old prosthesis (general, retention, stability, comfort, pronunciation, chewing, esthetics), and technical quality of the old prostheses as assessed by a dentist (stability, retention, fit, border, wear, esthetics). Gender, age, and a cognitive screening test were included as confounding variables. Mann-Whitney-U tests and linear mixed model analysis were performed.

Results: All individual satisfaction items significantly improved with new prostheses for maxillary and mandibular jaws. *TSP3* was higher for maxillary prostheses, if retention satisfaction with the old prosthesis was good, and if the dentist assessed the esthetics of the old prosthesis as deficient. *CTS3* was associated with male gender, dissatisfaction with chewing before treatment, and dissatisfaction with esthetics before treatment.

Conclusions: This pilot study showed that satisfaction 3 months after new denture insertion was associated with aspects of satisfaction and quality related to the old prosthesis, type of jaw, and gender. These factors may help dentists predict therapeutic benefits when deciding on the need for denture replacement. Further research should be done with a greater number of subjects and should include balanced quantities of the different types of dentures.

Aging populations, associated with longer life expectancy and declining fertility rates, have been reported as one trait of modern Western societies.[1] The World Health Organization (WHO) has predicted that the proportion of the population aged 60 years and older will be 30% or more in 2050 in most Western countries.[2] At the same time, the prevalence of edentulism has been declining.[3] This has been attributed to a raised consciousness about oral health and appearance, combined with a professional oral care approach that follows the principles of prevention and minimally invasive dentistry.[4] However, due to the aging population, the absolute number of partially and completely edentulous patients still is considerable, as is their need for treatment.[5-7]

In the last decades, dental implants have become available to optimize support and retention for partial or complete dentures.[8] Implant-supported/retained overdentures have been

suggested as one standard of care for the edentulous mandibular arch.[9] Unfortunately, treatment with dental implants is not available for every patient due to financial, anatomical, and medical limitations. As a consequence, conventional removable dentures have remained relevant for the treatment of lost teeth and soft tissues.[10-14]

One aspect of clinical success of denture treatment can be assessed in terms of patient satisfaction.[15,16] Satisfaction outcomes have been reported to be easy to measure and to allow direct quantification of patients' opinions and feelings towards different aspects of prosthodontic treatment. Satisfaction measures have been found to be associated with oral health-related quality of life (OHRQoL) and were used to detect clinically significant differences between various prosthodontic treatments.[17-20]

While many patients have been reported to be content with removable dentures, a small proportion have had long-term problems.[10,21-25] Langer et al reported that of their 127 subjects who had received complete dentures, 69% were completely satisfied, 19% were satisfied with minor objections, and 12% were dissatisfied.[16] Al-Omiri et al found that10% of the subjects were not satisfied with their technically successful removable dentures.[26]

A thorough understanding of the parameters that influence patient satisfaction might help to predict treatment outcome and could hence be useful in deciding whether denture replacement is meaningful.[27,28] Ambiguous results on satisfaction have been found concerning the effect of anatomic and physiological parameters and technical denture quality.[10,23,27,29-34] The clinical experience of the treating or attending dentists, the relationships between patients and practitioners as well as the demographic and psychological profile of patients have also been reported to play a role.[10,26,35-42] Instead of one single factor, interaction of psychological, biological, anatomical, and technical elements seemed to determine patient satisfaction.[16,43]

For dental clinicians, those factors might be considered most relevant that can be detected before starting the treatment without being too obtrusive. Consequently, this pilot study used subjects with previous denture-wearing experience to investigate if aspects of satisfaction and technical quality related to the old prosthesis affected satisfaction after denture renewal. The effect of the subject's motivation for denture renewal and type of jaw were also studied. These variables were complemented by the following covariates: gender, age, and a cognitive screening test.

Materials and methods

Subjects

Fifty-eight non-hospitalized patients presenting at the Department of Prosthetic Dentistry of the University Hospitals Leuven with the request to replace their existing removable dentures were recruited to participate in the study. Edentulous and partially dentate subjects were selected. Inclusion criteria required that subjects were able to communicate clearly with the clinician and complete a questionnaire. Eight were excluded because of the following reasons: refusal to complete the follow-up questionnaire (n = 3), discontinued treatment (n = 2), death shortly after prosthesis insertion (n = 2), and payment inconveniences (n = 1). No other exclusion criteria were applied.

Data and data collection

The study was conducted in Leuven, Belgium according to the ICH-GCP (International Conference on Harmonization Guidelines on Good Clinical Practice) principles. Approval was obtained from the ethical committee of the University Hospitals Leuven (protocol number s52765) before commencing the study. All subjects were informed of the aims and procedures of the study, and written consent was acquired.

Data collection took place between August 2012 and May 2014. Prior to treatment, a clock drawing test (CDT) was administered to evaluate the cognitive condition of the subjects. For scoring, the Shulman 0 to 5 system was used, with higher values representing more proficient performances.[44-46] Also, the subject's reason for requesting new dentures was recorded. One or more of the following reasons could be selected: poor prosthesis fit, poor esthetics, wear, damage, recent tooth extractions, and advice of the dentist. Satisfaction was assessed before treatment and 3 months after prosthesis insertion by a self-administered questionnaire. The same instrument was used before and after treatment. The 3-month period has also been used by other studies and was chosen to allow the subjects to become habituated to the new dentures.[23,26,27,33] Based on Scott et al's study, the questionnaire consisted of 7 items related to denture satisfaction, separated for maxillary and mandibular prostheses.[47] General satisfaction, satisfaction with retention, stability, comfort, pronunciation, chewing, and esthetics were measured on a 5-point scale, with higher scores representing higher values of satisfaction. Subjects who refused to return to the hospital for the follow-up appointment were asked to complete the questionnaire by mail (n = 7).

Technical quality of the dentures was assessed before starting treatment and 3 months after insertion by the same experienced dentist (LC). The same scoring method was used for both assessments. Stability, retention, border fit, general fit, wear, and esthetics were evaluated on a 4-point scale, with higher values indicating higher quality. The criteria were predefined during a meeting of the supervising dentists involved in removable dental prosthesis training at the KU Leuven Department of Oral Health Sciences. Guidelines published by McCord and Grant were used as a basis for discussion.[48] To evaluate retention, subjects were asked to perform the following actions: swallow, count from 1 to 10, protrude and laterotrude the mandible and the tongue, and inflate the cheeks. Furthermore, the evaluator tried to remove the prosthesis by pulling simultaneously on two symmetrically positioned teeth of the prosthesis. The retention score was determined by the ease of dislodgement of the prosthesis following these manipulations. To evaluate stability, the assessor alternately pressed a finger on the occlusal surfaces of the right and left premolar/canine region. Stability was scored depending on the presence and the extent of rotational or rocking moments of the prosthesis. The assessment of border fit evaluated the correct length of prosthesis flanges as well as the presence of sharp or rough edges. General fit was defined as a global evaluation item, combining denture stability, retention, and border fit. The evaluation of wear included

the presence and extent of tooth abrasion, thin or broken edges of the incisors, and damage at the prosthesis base. Tooth shade, lip support, discoloration, the buccal corridors, positioning and harmony of the teeth, gingival contouring, and occlusal planes were assessed when evaluating prosthesis esthetics. For partial prostheses, only the applicable criteria were applied. Technical quality scores after treatment could not be obtained for those subjects who refused to return for the follow-up appointment (n = 7).

Treatment and fabrication of dentures

Denture treatment was carried out at the Department of Prosthetic Dentistry of the University Hospitals Leuven, either by a postgraduate student or by an undergraduate student under supervision of experienced prosthodontists. One pair of dentures was made with the copy technique,[47,49] while the others were made according to the conventional protocol taught at the KU Leuven Department of Oral Health Sciences. This procedure was based on the Dutch manual published by Kalk et al.[49] Preliminary impressions were made with irreversible hydrocolloid (alginate Aroma Fine Plus Fast Set; GC, Leuven, Belgium) in prefabricated trays (Schreinemakers Border-Lock impression trays; Clan, Maarheeze, The Netherlands). Flanges of the edentulous parts of definitive impression trays were extended by border molding using dental compound (red ISO Functional Sticks; GC; and green Impression compound; Kerr, Orange, CA). Definitive impressions were made with a soft medium-body polyether impression material (Impregum; 3M ESPE, St. Paul, MN). Acrylic resin baseplates with wax occlusal rims were applied for jaw relation records. The maxillary master cast was placed in a semi-adjustable articulator by the arbitrary technique. For edentulous subjects, the positions of the mandibular master casts were defined by the centric jaw relation using the guided-closure technique. Bilateral balanced occlusal schemes were used for fabrication of all dentures.[49] Resin Candulor Physio Set TCR (Candulor AG, Glattpark, Swizterland) teeth were used for the replacement of incisors and canines. For premolars and molars the Bonartic TCR (Candulor) system was applied. After the wax denture trial insertion, all dentures were fabricated in the same dental laboratory by the compression molding technique. A control appointment was scheduled 1 week after insertion. Different types of removable dentures were included in this study: partial metal-based (n = 9), partial resin (n = 11), and complete (n = 54) prostheses in maxillary and/or mandibular jaws.

Variables and statistical analysis

Total satisfaction 3-month postinsertion (TSP3) and *change of total satisfaction 3-month postinsertion (CTS3)* were used as outcome variables. The sum-index *TSP3* merged the values of 6 individual satisfaction items, measured after treatment: retention, stability, comfort, pronunciation, chewing, and esthetics. The resulting variable had a theoretical range from 0 to 24, with higher scores representing higher total satisfaction after treatment. The outcome *CTS3* was defined as difference between *total satisfaction pre* (index, created in the same way as *TSP3*) and *TSP3*. After recoding, values between 0 and 23 represented a deterioration of total satisfaction, 24 indicated no change, and values between 25 and 48 represented an improvement of total satisfaction. Index formation was based on individual satisfaction variables that were scaled identically. Spearman's rank correlation coefficients between individual satisfaction variables were significantly positive ($p < 0.05$, mean across all conditions per subject, n = 50).

Twenty-three predictors were included in the analysis (Table 1). Categorical predictors were dichotomized to meet requirements of the statistical procedures applied to the data. For the variables representing the different aspects of satisfaction with the old prosthesis, dichotomization separated the three least favorable categories from the two most favorable (Fig 3). Variables representing the technical quality of the old prosthesis could not be dichotomized homogeneously, as the distribution differed markedly between these variables. Cut-off points were chosen to include at least 20% of the subjects in one of the two categories (Fig 4). For the clock drawing test, scores ≤ 3 represented a cognitive deficit, while scores >3 were considered as regular cognitive functioning.[29] Dichotomization of age was performed by median split.

Per outcome variable, exploratory Mann-Whitney-U tests were conducted with each possible predictor for maxillary and mandibular arch, respectively. Covariates and predictors with significant p-values were then included in a linear mixed model. The least significant factor was excluded stepwise, resulting in a model that exclusively consisted of covariates and significant predictors. As a number of subjects were provided with two dentures, subject identificator was included in the model as random effect to account for clustering of data.

For all statistical analyses, the significance level was set at $p < 0.05$. Analyses were performed with the statistical software package SPSS 21.

Results

Descriptive statistics

Fifty subjects received 74 new dentures: 48 maxillary arch (mx) and 26 mandibular arch (md). The study population consisted of 52% female subjects with the mean age of 68.2 ± 8.4 (range 53 to 89). The median of the clock-drawing test was 4 (range 1 to 5). Mean values of individual satisfaction items were significantly higher after treatment for maxillary and mandibular arches (Student's t-tests for related samples: $p \leq 0.001$ for General satisfaction mx, Satisfaction retention mx, Satisfaction retention md, Satisfaction stability mx, Satisfaction comfort mx, Satisfaction comfort md, Satisfaction chewing mx, Satisfaction esthetics mx, Satisfaction esthetics md; $p \leq 0.01$ for Satisfaction stability md, Satisfaction pronunciation mx, Satisfaction pronunciation md; $p \leq 0.05$ for General satisfaction md, Satisfaction chewing md (Fig 1). The mean of *TSP3* was 20.6 ± 4.1 (range 10 to 24 mx) and 16.6 ± 4.4 (range 10 to 24 mn). For *CTS3,* the mean was 29.6 ± 6.2 (range 11 to 42) for the maxillary and 30.4 ±7.3 (range 18 to 47) for the mandibular arch.

Figures 2 to 4 illustrate the distributions of the predictor variables. Figure 2 shows the reasons to ask for replacement, with poor fit and wear being the main reasons. Figure 3 illustrates satisfaction with the old prostheses. In general, nearly two-thirds of the subjects were very satisfied or satisfied with

Table 1 Man-Whitney-U tests for *TSP3* and *CTS3*, separated for maxillary and mandibular arch

		TSP3		*CTS3*	
Predictors		Maxilla	Mandible	Maxilla	Mandible
	Jaw	<0.001		0.928	
	Gender	0.214	0.574	0.052	0.013
	Age	0.432	0.816	0.562	0.336
	CDT	0.389	0.672	0.557	0.525
Reason for request	Fit	0.590	0.742	**0.031**	0.274
	Aesthetics	**0.017**	0.139	**0.014**	0.387
	Broken denture	0.717	0.692	0.154	0.923
	Wear	0.503	0.579	0.967	0.223
	Advice dentist	0.733	0.498	0.267	0.258
	Extraction	0.376	0.164	0.734	0.672
Satisfaction with old prosthesis	General	0.068	0.878	**0.049**	**0.003**
	Retention	**0.026**	**0.041**	**0.003**	0.880
	Stability	0.074	0.224	**<0.001**	0.200
	Comfort	0.158	0.224	**<0.001**	0.138
	Pronunciation	0.734	0.660	**<0.001**	**0.006**
	Chewing	0.832	0.397	**<0.001**	**0.001**
	Aesthetics	0.076	0.457	**<0.001**	**0.028**
Technical quality of old prosthesis	Stability	0.820	0.586	0.712	0.391
	Retention	0.633	0.324	0.888	0.295
	Fit	0.341	0.421	0.983	0.421
	Border	0.448	0.429	0.204	0.397
	Wear	0.342	0.102	0.680	0.807
	Aesthetics	**0.017**	0.263	**0.007**	0.263

Bold values significant at $p < 0.05$.

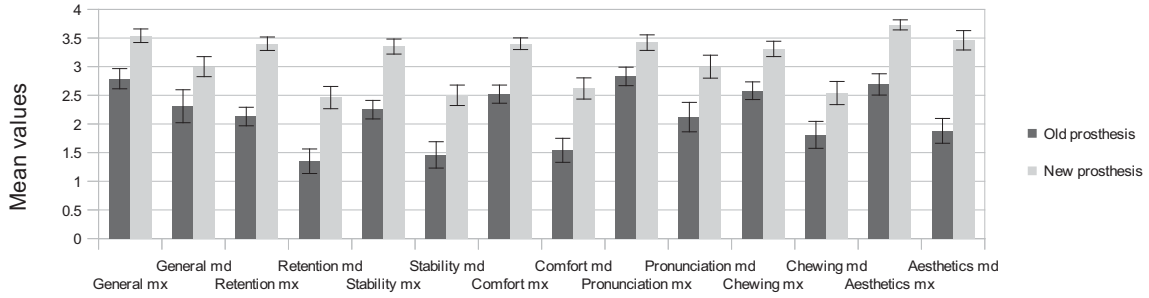

Figure 1 Mean values individual satisfaction items for old and new prostheses with error bars (standard error), for maxilla (mx) and mandible (md).

their old prostheses. Technical quality of the old prostheses as assessed by a dentist is shown in Figure 4. About two-thirds of the prostheses still had acceptable or good stability, but none had acceptable or good esthetics.

Mann-Whitney-U tests and linear mixed models

Per outcome variable, separate Mann-Whitney-U tests were performed with all covariates and predictors for maxillary and mandibular arch (Table 1), and a linear mixed model was calculated. After refining by stepwise exclusion of the least significant predictor, the models exclusively consisted of covariates and significant predictors.

TSP3 was significantly higher for the maxillary arch, when the subject was more satisfied with the retention of the old prosthesis, and when the dentist assessed the esthetics of the old prosthesis as deficient (Table 2). *CTS3* was significantly higher with male gender, lower satisfaction with chewing before treatment, and lower satisfaction with esthetics before treatment (Table 3).

Discussion

This pilot study analyzed if patient satisfaction after conventional denture treatment was associated with the reasons for requesting denture renewal, and with different aspects of satisfaction and quality related to preexisting prostheses. The study had a number of significant limitations. The fact that all denture quality assessments were done by the same dentist assured uniform scoring, but potentially compromised reproducibility of results. Moreover, due to the small sample size, results should

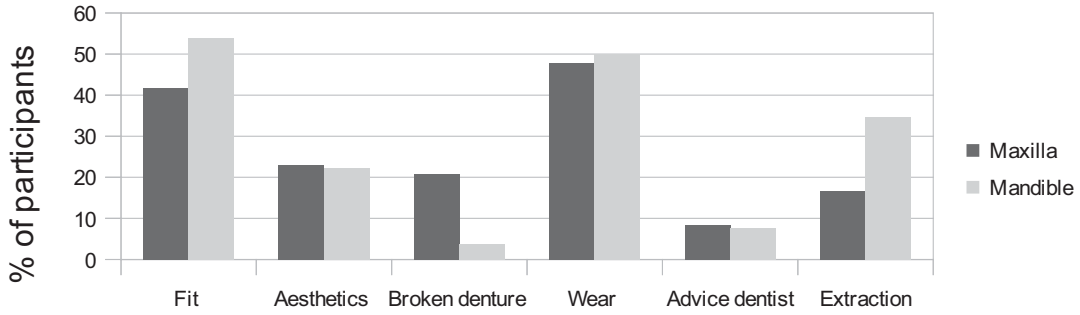

Figure 2 Reason of request per jaw.

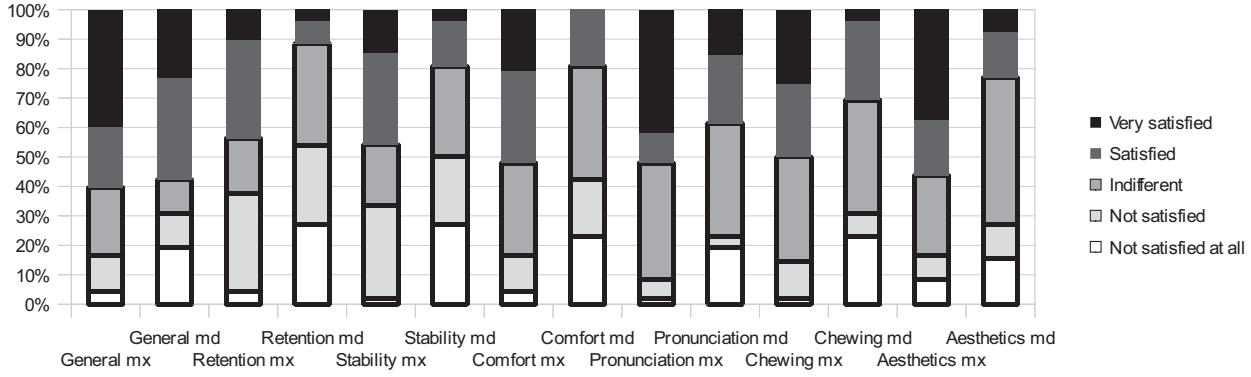

Figure 3 Satisfaction with old prosthesis maxilla (mx) and mandible (md), black margin indicates dichotomization.

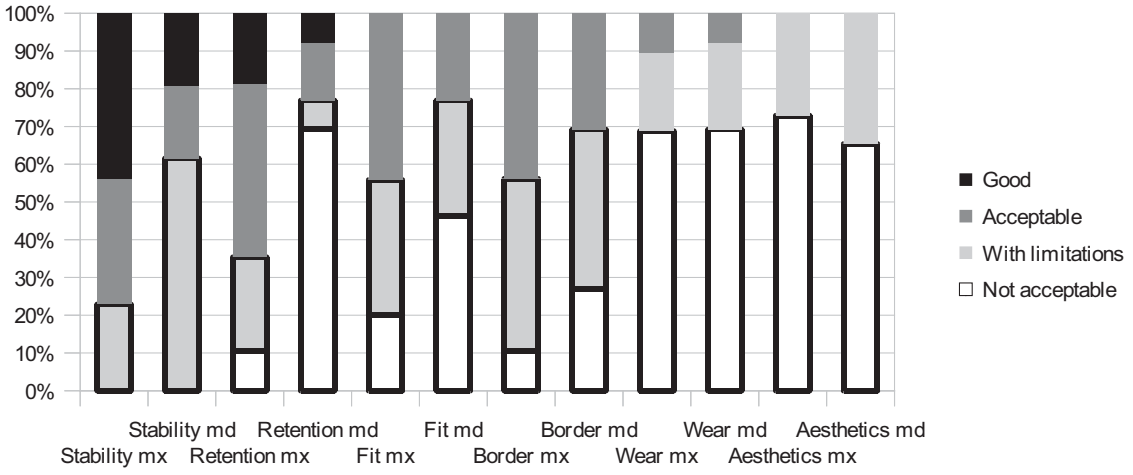

Figure 4 Technical quality old prosthesis for maxilla (mx) and mandible (md), black margin indicates dichotomization.

be extrapolated with caution. The limited number of subjects also affected dichotomization of the technical-quality variables. Furthermore, complete and partial dentures were included in unbalanced quantities. Satisfaction differences between these two groups have been reported.[20,22] The limitation to only one follow-up measurement also needs to be considered, because it has been shown that denture satisfaction evolves over time.[31] The fact that the new dentures were fabricated by postgraduate or undergraduate students might also have compromised the quality of the study; however, all dentures were made under strict supervision of experienced prosthodontists.

Prosthodontic replacement aims to reach high absolute patient satisfaction with the new prosthesis as well as improvement of satisfaction when comparing new and old dentures. Consequently, *TSP3* and *CTS3* were used to operationalize therapeutic benefits, with *CTS3* being less sensitive to response bias caused by a subject's tendency to answer predominantly favorable or unfavorable.

Table 2 Final linear mixed model for *TSP3*

	Estimate	Standard error	Significance	95% Confidence interval
Jaw (maxilla = 0, mandible = 1)	**−2.44**	**0.96**	**0.013**	**−4.35 - −0.52**
Satisfaction old prosthesis, retention	**3.34**	**0.98**	**0.001**	**1.40 - 5.29**
Technical quality old prosthesis, eesthetics	**−2.22**	**1.02**	**0.033**	**−4.25 - −0.18**
Gender (female = 0, male = 1)	1.02	0.99	0.308	−0.96 - 3.00
Age	1.30	0.88	0.146	−0.46 - 3.06
CDT	1.01	0.97	0.299	−0.92 - 2.94

Bold values significant at $p < 0.05$.

Table 3 Final linear mixed model for *CTS3*

	Estimate	Standard error	Significance	95% Confidence interval
Satisfaction old prosthesis, chewing	**−4.27**	**1.14**	**<0.001**	**−6.56 to −1.99**
Satisfaction old prosthesis, esthetics	**−5.99**	**1.09**	**<0.001**	**−8.16 to −3.83**
Gender (female = 0, male = 1)	**5.09**	**1.01**	**<0.001**	**3.09 to 7.10**
Age	1.78	0.97	0.072	−0.16 to 3.72
CDT	−0.03	1.09	0.977	−2.21 to 2.14

Bold values significant at $p < 0.05$.

For all individual aspects of satisfaction, mean values were significantly higher with the new prosthesis than with the previous prosthesis (Fig 1). Mean values for *TSP3* indicated a distribution skewed towards values of higher satisfaction. This evolution was also reflected by the *CTS3*. These results are in line with international literature.[10] While 60% of the subjects in the Berg's study were dissatisfied with their old prosthesis, only 15% expressed dissatisfaction with the new prosthesis.[34] Al-Omiri et al reported that satisfaction with appearance, pain tolerance, oral comfort, eating and total satisfaction had improved after removable denture treatment.[26]

Langer et al found almost no correlation between patients' appraisals and the dentist's assessment of the same dentures.[16] Zlatarić and Celebić reported that dentures were assessed more favorable by the patient than by the dentist.[24] In the current study the esthetic assessment of the old dentures differed markedly between subjects and dentist, with the subjects being much more positive.

The main scope of this study was to identify predictors for denture satisfaction that can be obtained before starting the treatment procedure. Multivariable analysis showed that *TSP3* was significantly higher if the prosthesis was situated in the maxillary arch, if the subject was more satisfied with the retention of the old prosthesis, and if the dentist had assessed esthetics of the old prosthesis as deficient (Table 2).

Higher satisfaction values for maxillary prostheses might be explained by the larger anatomical stabilization area created by the hard palate. This result agrees with the findings of Carlsson et al and Perea et al, while de Siqueira et al and Al-Omiri et al found no effect of the type of jaw.[13,14,26,33,43]

The impact of retention satisfaction before treatment might be mediated by anatomical conditions as well. If the jawbones provided sufficient retention to the old prosthesis, fabrication of a satisfying new denture is more feasible. This theory was supported by the results of van Waas, who found oral tissue quality significantly associated with denture satisfaction.[33] The anatomy of the mandibular ridge was repeatedly shown to predict satisfaction after treatment.[27,29,32,39]

If the esthetics of the old prosthesis were considered suboptimal, fabrication of satisfying new prostheses might have been easier; however, esthetic satisfaction with the old prostheses as well as esthetics as a reason to ask for fabrication of new dentures were not associated with *TSP3* in multivariable analysis. As outlined earlier, subjects tended to be less critical than the dentist concerning esthetics of old prostheses. Because of their everyday exposure, they might have been less conscious about the deteriorated appearance of their denture, but appreciated improved esthetics after renewal.

Focusing on the second outcome variable, *CTS3* was significantly higher for men and for those who were less satisfied with esthetics and chewing before treatment (Table 3). In accordance with the results of the current study, female subjects in Pan et al's study scored significantly lower on several satisfaction dimensions 6 months after denture renewal.[40] Al-Omiri et al confirmed that female subjects were significantly less satisfied with appearance after denture treatment.[26] Furthermore, female subjects needed more appointments for adjustment and modification after insertion.[41] These differences might be attributable to a combination of physiological, psychological, and social factors.[40] However, Perea et al reported a slight tendency of lower OHRQoL in male subjects after denture treatment.[13] Other studies found no gender effects on denture satisfaction.[14,16,43]

Dissatisfaction with esthetics before treatment was also found to be associated with higher *CTS3*. A dental prosthesis is prominently situated in the face and as such is noticed by the patient and by others during social interaction. By that, dissatisfaction with denture esthetics can be related to feelings of embarrassment and shame. Berg et al showed the impact

of other people's opinions on denture appraisal.[42] Comprehensively, an esthetic new denture improved total satisfaction; however, esthetics as the reason for requesting denture renewal and the esthetic assessment of the dentist were not associated with the outcome variable in multivariable analysis.

In the current study, dissatisfaction with chewing before treatment was also associated with higher *CTS3*. The impact of chewing satisfaction with the old prosthesis has never been analyzed before, but it was repeatedly shown that chewing satisfaction significantly contributed to denture appraisal after denture treatment.[28,29]

Outcome variables were not affected by the age of the subjects in the current study. This result is supported by Akeel and Perea et al, who found no association between age as a modulating variable, satisfaction and OHRQoL.[13,30] On the other hand, Pistorius et al reported higher OHRQoL for older removable denture wearers.[19] Similarly, removable denture wearers under the age of 60 expressed more dissatisfaction than older subjects in Frank et al's study.[25]

In the present study, outcome variables were not affected by the cognitive status of the subjects. As an easy to use and sensitive cognitive screening instrument the CDT has been widely used as an adjunct to the Mini-Mental-State Examination.[45] As the CDT primarily tests executive cognitive function, further research should use alternative measures that represent a more global measurement for cognitive functioning.[46]

Conclusion

This pilot study showed that patient satisfaction 3 months after insertion of new dentures was associated with aspects of satisfaction and quality related to the old prosthesis, type of jaw, and gender. These factors may help dental clinicians predict the therapeutic benefit when deciding on the need for denture replacement. Further research should be done with a higher number of subjects and should include balanced quantities of the different types of dentures.

Acknowledgments

The authors want to thank all the subjects who participated in this study. Without their cooperation, data collection would not have been possible.

References

1. Ezeh AC, Bongaarts J, Mberu B: Family planning 1 – Global population trends and policy options. Lancet 2012;380:142-148
2. World Health Organization: World report on ageing and health 2015 http://www.who.int/ageing/publications/world-report-2015/en/. Accessed May 9, 2016
3. Polzer I, Schimmel M, Müller F, et al: Edentulism as part of the general health problems of elderly adults. Int Dent J 2010;60:143-155
4. Wu B, Liang J, Plassman BL, et al: Edentulism trends among middle-aged and older adults in the United States: comparison of five racial/ethnic groups. Community Dent Oral Epidemiol 2012;40:145-153
5. Slade GD, Akinkugbe A, Sanders A: Projections of U.S. edentulism prevalence following 5 decades of decline. J Dent Res 2014;93:959-965
6. Müller F, Naharro M, Carlsson GE: What are the prevalence and incidence of tooth loss in the adult and elderly population in Europe? Clin Oral Implants Res 2007;18(Suppl 3):2-14
7. Mojon P, Thomason JM, Walls AWG: The impact of falling rates of edentulism. Int J Prosthodont 2004;17:434-440
8. Allen EP, Brodine AH, Burgess JO, et al: Annual review of selected dental literature: report of the Committee on Scientific Investigation of the American Academy of Restorative Dentistry. J Prosthet Dent 2006;96:174-199
9. Feine JS, Carlsson GE, Awad MA, et al: The McGill consensus statement on overdentures. Mandibular two-implant overdentures as first choice standard of care for edentulous patients. Montreal, Quebec, May 24-25, 2002. Int J Oral Maxillofac Implants 2002;17:601-602
10. Carlsson GE, Omar R: The future of complete dentures in oral rehabilitation. A critical review. J Oral Rehabil 2010;37:143-156
11. Chrcanovic BR, Albrektsson T, Wennerberg A: Reasons for failures of oral implants. J Oral Rehabil 2014;41:443-476
12. Bornstein MM, Cionca N, Mombelli A: Systemic conditions and treatments as risks for implant therapy. Int J Oral Maxillofac Implants 2009;24 Suppl:12–27
13. Perea C, Suarez-Garcia M, Del Rio J, et al: Oral health-related quality of life in complete denture wearers depending on their socio-demographic background, prosthetic-related factors and clinical condition. Med Oral Patol Oral Cir Bucal 2013;18:e371–e380
14. de Siqueira GP, dos Santos MBF, dos Santos JFF, et al: Patients' expectation and satisfaction with removable dental prosthesis therapy and correlation with patients' evaluation of the dentists. Acta Odontol Scand 2013;71:210-214
15. Jacob RF: The traditional therapeutic paradigm: complete denture therapy. J Prosthet Dent 1998;79:6-13
16. Langer A, Michman J, Seifert I: Factors influencing satisfaction with complete dentures in geriatric patients. J Prosthet Dent 1961;11:1019–1031
17. Michaud P-L, de Grandmont P, Feine JS, et al: Measuring patient-based outcomes: is treatment satisfaction associated with oral health-related quality of life? J Dent 2012;40:624-631
18. Al-Omiri MK, Karasneh J: Relationship between oral health-related quality of life, satisfaction, and personality in patients with prosthetic rehabilitations. J Prosthodont 2010;19:2-9
19. Pistorius J, Horn JG, Pistorius A, et al: Oral health-related quality of life in patients with removable dentures. Schweiz Monatsschr Zahnmed 2013;123:964-71
20. Gjengedal H, Berg E, Boe OE, et al: Self-reported oral health and denture satisfaction in partially and completely edentulous patients. Int J Prosthodont 2011;24:9-15
21. Carlsson GE: Clinical morbidity and sequelae of treatment with complete dentures. J Prosthet Dent 1998;79:17-23
22. Čelebić A, Knezović-Zlatarić D: A comparison of patient's satisfaction between complete and partial removable denture wearers. J Dent 2003;31:445-451
23. Alfadda SA: The relationship between various parameters of complete denture quality and patients' satisfaction. J Am Dent Assoc 2014;145:941-948
24. Zlatarić DK, Celebić A: Treatment outcomes with removable partial dentures: a comparison between patient and prosthodontist assessments. Int J Prosthodont 2001;14:423-426
25. Frank RP, Milgrom P, Leroux BG, et al: Treatment outcomes with mandibular removable partial dentures: a population-based study of patient satisfaction. J Prosthet Dent 1998;80:36-45

26. Al-Omiri MK, Sghaireen MG, Al-Qudah AA, et al: Relationship between impacts of removable prosthodontic rehabilitation on daily living, satisfaction and personality profiles. J Dent 2014;42:366-372
27. Fenlon MR, Sherriff M: An investigation of factors influencing patients' satisfaction with new complete dentures using structural equation modelling. J Dent 2008;36:427-434
28. Sato Y, Hamada S, Akagawa Y, et al: A method for quantifying overall satisfaction of complete denture patients. J Oral Rehabil 2000;27:952-957
29. Yamaga E, Sato Y, Minakuchi S: A structural equation model relating oral condition, denture quality, chewing ability, satisfaction, and oral health-related quality of life in complete denture wearers. J Dent 2013;41:710-717
30. Akeel RF: Effect of the quality of removable prostheses on patient satisfaction. J Contemp Dent Pract 2009;10:E057-64
31. Fenlon MR, Sherriff M: Investigation of new complete denture quality and patients' satisfaction with and use of dentures after two years. J Dent 2004;32:327-333
32. Wolff A, Gadre A, Begleiter A, et al: Correlation between patient satisfaction with complete dentures and denture quality, oral condition, and flow rate of submandibular/sublingual salivary glands. Int J Prosthodont 2003;16:45-48
33. van Waas MA: Determinants of dissatisfaction with dentures: a multiple regression analysis. J Prosthet Dent 1990;64:569-572
34. Berg E: The influence of some anamnestic, demographic, and clinical variables on patient acceptance of new complete dentures. Acta Odontol Scand 1984;42:119-127
35. Hirsch B, Levin B, Tiber N: Effects of dentist authoritarianism on patient evaluation of dentures. J Prosthet Dent 1973;30:745-748
36. Guckes AD, Smith DE, Swoope CC: Counseling and related factors influencing satisfaction with dentures. J Prosthet Dent 1978;39:259-267
37. Kimoto S, Kimoto K, Kitamura A, et al: Effect of dentist's clinical experience on treatment satisfaction of a complete denture. J Oral Rehabil 2013;40:940-947
38. Fenlon MR, Sherriff M, Newton JT: The influence of personality on patients' satisfaction with existing and new complete dentures. J Dent 2007;35:744-748
39. Critchlow SB, Ellis JS: Prognostic indicators for conventional complete denture therapy: a review of the literature. J Dent 2010;38:2-9
40. Pan S, Awad M, Thomason JM, et al: Sex differences in denture satisfaction. J Dent 2008;36:301-308
41. Panek H, Krawczykowska H, Dobosz A, et al: Follow-up visits as a measure of adaptation process to removable prostheses. Gerodontology 2006;23:87-92
42. Berg E, Johnsen TB, Ingebretsen R: Social variables and patient acceptance of complete dentures. A study of patients attending a dental school.Acta Odontol Scand 1985;43:199-203
43. Carlsson G, Otterland A, Wennström A, et al: Patient factors in appreciation of complete dentures. J Prosthet Dent 1967;17:322-328
44. Shulman KI, Gold DP, Cohen CA: Clock-drawing and dementia in the community: a longitudinal study. Int J Geriatr Psychiatry 1993;8:487-496
45. Shulman KI: Clock-drawing: is it the ideal cognitive screening test? Int J Geriatr Psychiatry 2000;15:548-561
46. Bossers WJR, van der Woude LH V, Boersma F, et al: Recommended measures for the assessment of cognitive and physical performance in older patients with dementia: a systematic review. Dement Geriatr Cogn Dis Extra 2012;2:589-609
47. Scott BJJ, Forgie AH, Davis DM: A study to compare the oral health impact profile and satisfaction before and after having replacement complete dentures constructed by either the copy or the conventional technique. Gerodontology 2006;23:79-86
48. McCord JF, Grant AA: Clinical assessment. Br Dent J 2000;188:375-380
49. Kalk W, van Waas MAJ, van Os JH, et al: De volledige gebitsprothese in woord en beeld (ed 2). In Kalk W, van Waas MAJ, van Os JH, et al (eds): Houten/Diegem, Bohn Stafleu Van Loghum, 2001